IN THE CLAIMS:

Pending claims are as follows:

1. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information;

determining a first location estimate based on the at least one selected location method;

determining a virtual base station estimate using at least some of the collected location information; and

providing a second location estimate using one of said different location methods based on the first location estimate and the virtual base station estimate, said second location estimate being a location of a mobile device.

2. (Previously Presented) A method as claimed in claim 1, wherein said at least one location method comprises at least one of:

using cell identity information;

using cell identity information and received signal strength;

using cell identity information and timing advance information; and

using cell identity information, received signal strength information and timing advance information.

3. (Cancelled)

4. (Previously Presented) A method as claimed in claim 2, further comprising determining the virtual base station estimate, using at least one of the cell identity information, cell identity information and received signal strength, cell identity information and timing advance information, and using cell identity information, received signal strength information and timing advance information.

5. (Previously Presented) A method as claimed in claim 1, wherein said virtual base station location estimate is coupled with at least one virtual measurement and at least one real measurement, said at least one virtual measurement being processed using a location method.

6. (Previously Presented) A method as claimed in claim 2, wherein providing said second location estimate comprises processing said virtual base station location estimate is coupled with at least one virtual measurement and at least one real measurement, said at least one virtual measurement being processed using a location method, and wherein the at least one real and the at least one virtual measurements are processed using at least one of cell identity information, cell identity information and received signal strength, cell identity information and timing advance information, and

using cell identity information, received signal strength information and timing advance information.

7. (Previously Presented) A method as claimed in claim 5, wherein a value for the virtual measurement is one of measured levels, a combination of measured levels, and an average of measured levels.

8. (Previously Presented) A method as claimed in claim 1, wherein said at least one location method is selected in dependence on the location information available.

9. (Previously Presented) A method as claimed in claim 1, wherein a plurality of location estimates are determined and at least one estimate is used to provide said location estimate.

10. (Previously Presented) A method as claimed in claim 1, wherein said location information is collected by said mobile device.

11. (Previously Presented) A method as claimed in claim 10, wherein said mobile device is configured to measure a level of at least one type of information.

12. (Previously Presented) A method as claimed in claim 1, wherein said location information comprises at least one of timing advance information and received signal level.

13. (Original) A method as claimed in claim 12, wherein said received signal level is an absolute received signal level or relative received signal level.

14. (Previously Presented) A method as claimed in claim 1, wherein said mobile device is in a cellular communications device.

15. (Original) A method as claimed in claim 14, wherein said information is collected for a serving cell of the mobile device.

16. (Previously Presented) A method as claimed in claim 14, wherein said information is collected for at least one neighbouring cell.

17. (Previously Presented) A method as claimed in claim 14, further comprising selecting the or each cell in respect of which location information is collected.

18. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information;

providing a location estimate of the mobile device based on the at least one selected location methods,

wherein the location estimate is provided using the following algorithm

calculate the total attenuation experienced by a signal transmitted by the i-th BTS while propagating toward a mobile station where i-th level observation is L^i) by subtracting from the i-th measured received power, P^i_r, the maximum power radiated by the i-th BTS, $P^i_{t,max}$:

$$L^i = P_r^i - P_{t,max}^i \quad ; \quad i = 1,\ldots,N$$

stack the level observations from N BTS's in vector **L**:

$$\mathbf{L} = \left[L^1,\ldots,L^N\right]^T$$

solve the minimization problem:

$$\begin{bmatrix} \hat{\sigma_u}^2 \\ \hat{x} \\ \hat{y} \end{bmatrix} = \arg \min_{\begin{bmatrix} \sigma_u^2 \\ x \\ y \end{bmatrix}} F\left(x,y;\sigma_u^2\right)$$

where the *cost function F (x,y;* σ_u^2) is defined as follows:

$$F\left(x,y;\sigma_u^2\right) = \ln \sigma_u^2 + \ln |\mathbf{r_L}(x,y)| + \frac{1}{\sigma_u^2} [\mathbf{L} - \mathbf{m_L}(x,y)]^T \mathbf{r_L}^{-1}(x,y) [\mathbf{L} - \mathbf{m_L}(x,y)]$$

and

$$\mathbf{m_L}(x,y) = \left[\mu_L^1(x,y),\ldots,\mu_L^N(x,y)\right]^T$$

$$\mu_L^i(x,y) = -\mathrm{PL}^i\left(d^i(x,y)\right) - AP_{tr}^i\left(\psi^i(x,y)\right)$$

$$[\mathbf{r_L}(x,y)]_{ij} = \begin{cases} 1 & i=j \\ \rho_u^{i,j}(x,y) & i\neq j \end{cases} \qquad i,j = 1,\ldots,N$$

determining the location of a mobile device dependent on the location estimate.

19. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information; and

providing a location estimate based on the at least one selected location method, wherein a location estimate is provided using the following algorithm

calculate the total attenuation experienced by a signal transmitted by the i-th BTS while propagating toward a mobile station where the i-th level observation is L^i by subtracting from the i-th measured received power, P^i_r, the maximum power radiated by the i-th BTS, $P^i_{t,max}$:

$$L^i = P_r^i - P_{t,max}^i \quad ; \quad i = 1,\ldots,N$$

stack level observations from *N* BTS's in vector **L**:

$$\mathbf{L} = \left[L^1,\ldots,L^N\right]^T$$

solve the minimization problem:

$$\begin{bmatrix} \hat{x} \\ \hat{y} \end{bmatrix} = \arg \min_{\begin{bmatrix} x \\ y \end{bmatrix} \in D_{xy}} F(x,y)$$

where the *cost function F(x,y)* is defined as follows:

$$F(x,y) = \sum_{i=1}^{N} \left(L^i + \mathrm{PL}^i(x,y) + AP^i_{tr}(x,y) \right)^2$$

and D_{xy} is the domain of existence of x and y.

calculate $\hat{\sigma}_u^2$ as

$$\hat{\sigma_u}^2 = F(\hat{x},\hat{y})$$

,

determining the location of a mobile device dependent on the location estimate.

20. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information; and

providing a location estimate based on the at least one selected location method,

wherein a location estimate is provided using the following algorithm:

calculate the total attenuation experienced by a signal transmitted by the i-th BTS while propagating toward a mobile station where the i-th *level observation* is L^i) by subtracting from the i-th *measured* received power, Pt, the maximum power radiated by the i-th BTS, $P^i_{t,max}$:

$$L^i = P_r^i - P_{t,max}^i \quad ; \quad i = 1,\ldots,N$$

calculate the j-th *level difference observation* by subtracting the j-th level observation from the level observation L^1 taken as reference:

$$D^j = L^1 - L^j \quad ; \quad j = 2,\ldots,N$$

stack the *N - 1* difference of level observations in a vector **D**:

$$\mathbf{D} = \left[D^2,\ldots,D^N\right]^T$$

solve the minimization problem

$$\begin{bmatrix} \hat{x} \\ \hat{y} \end{bmatrix} = \arg \min_{\begin{bmatrix} x \\ y \end{bmatrix} \in \mathcal{D}_{xy}} F(x,y)$$

where

$$F(x,y) = \sum_{j=2}^{N} \left(D^j - \mu_D^j(x,y)\right)^2 - \frac{1}{N}\left(\sum_{j=2}^{N} D^j - \mu_D^j(x,y)\right)^2$$

and

$$\mu_D^j(x,y) = -\left[\mathrm{PL}^1\left(d^1(x,y)\right) - \mathrm{PL}^j\left(d^j(x,y)\right)\right] - \left[AP_{tr}^1\left(\psi^1(x,y)\right) - AP_{tr}^j\left(\psi^j(x,y)\right)\right]$$

D_{xy} is the domain of existence of x and y,

determining the location of the mobile device dependent on the location estimate.

21. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information; and

providing a location estimate based on the at least one selected location method,

wherein a location estimate is provided using an algorithm solving the following equation in x and y:

$$\begin{cases} \sum_{i=1}^{N} F^i(x,y)\left(x - x^i\right) = 0 \\ \qquad\qquad\qquad\qquad ; \quad (x,y) \in \mathcal{D} \\ \sum_{i=1}^{N} F^i(x,y)\left(y - y^i\right) = 0 \end{cases}$$

where

$$F^i(x,y) = \frac{2B^i/C^i(d_0)}{(2\pi)^{3/2}\sigma_u^i \ln 10} \frac{\exp\left\{-\frac{1}{2\sigma_u^{i\,2}}\left(B^i \log_{10} d^i(x,y) - z^i + A^i\right)^2\right\}}{[d^i(x,y)]^4} \cdot \left[\frac{B^i\left(B^i \log_{10} d^i(x,y) - z^i + A^i\right)}{2\sigma_u^{i\,2} \ln 10} - 1\right]$$

determining the location of a mobile device dependent on the location estimate.

22. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information; and

providing a location estimate based on the at least one selected location method,

wherein a location estimate is provided using an algorithm solving the following equation in x and y:

$$\begin{cases} \sum_{i=1}^{N}\left[-\frac{\mathcal{I}_i}{|\mathbf{R}|}(x-x^i)-\frac{(\tilde{\mathcal{I}}_i-1)}{|\mathbf{R}|}\left\{(x^i)^2x-x^iy^i(y-y^i)\right\}\right]=0 \\ \sum_{i=1}^{N}\left[-\frac{\mathcal{I}_i}{|\mathbf{R}|}(y-y^i)-\frac{(\tilde{\mathcal{I}}_i-1)}{|\mathbf{R}|}\left\{(y^i)^2y-x^iy^i(x-x^i)\right\}\right]=0 \end{cases} \quad ; \quad (x,y)\in\mathcal{D} \,,$$

determining the location of a mobile device dependent on the location estimate.

23. (Previously Presented) A method, comprising:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information; and

providing a location estimate based on the at least one selected location method,

wherein a location estimate is provided using an algorithm based on the following equation in x and y:

$$\hat{x}=\frac{\sum_{i=1}^{N}\frac{x^i}{\mathcal{I}_{i0}}}{\sum_{i=1}^{N}\frac{1}{\mathcal{I}_{i0}}} \quad ; \quad \hat{y}=\frac{\sum_{i=1}^{N}\frac{y^i}{\mathcal{I}_{i0}}}{\sum_{i=1}^{N}\frac{1}{\mathcal{I}_{i0}}} \quad ; \quad (\hat{x},\hat{y})\in\mathcal{D} \,,$$

determining the location of a mobile device dependent on the location estimate.

24. (Previously Presented) A method as claimed in claim 1, wherein said location estimate is provided by one of a iterative and a closed form method.

25. (Previously Presented) A method as claimed in claim 1, wherein said location estimate is provided by one of a linear and non linear method.

26. (Previously Presented) A system, comprising:

collecting means for collecting location information;

selecting means for selecting at least one of a plurality of different location methods to provide a location estimate said methods using cell identity information;

location determining means for determining a first location estimate based on the at least one selected location method; and

estimate determining means for determining a virtual base station estimate, using one of said different location methods; and

providing means for providing a second location estimate based on at least one of the first location estimate and the virtual base station estimate, said second location estimate being an estimate of the location of a mobile device.

27. (Previously Presented) A system, comprising:

a collector configured to collect location information;

a selector configured to select at least one of a plurality of different location methods to provide a location estimate, said methods using cell identity information;

a determiner configured to determine a first location estimate based on the at least one selected location method and further configured to determine a virtual base station estimate; and

a provider configured to provide a second location estimate, using one of said different location methods based on the first location estimate and the virtual base station estimate, said second location estimate being an estimate of the location of a mobile device.

28. (Previously Presented) Apparatus, comprising:

a collector configured to collect location information;

a selector configured to select at least one of a plurality of different location methods to provide a location estimate, said methods using cell identity information;

a determiner configured to determine a first location estimate based on the at least one selected location method and further configured to determine a virtual base station estimate; and

a provider configured to provide a second location estimate, using one of said different location methods based on the first estimate and the virtual base station estimate, said second location estimate being an estimate of the location of the apparatus.

29. (Previously Presented) A computer program embodied on a computer readable medium, said computer program configured to control a processor to perform:

collecting location information;

selecting at least one of a plurality of different location methods to provide a location estimate said location methods comprising using cell identity information;

determining a first location estimate based on the at least one selected location method;

determining a virtual base station estimate using at least some of the collected location information; and

providing a second location estimate using one of said different location methods based on the first location estimate and the virtual base station estimate, said second location estimate being a location of a mobile device.

REMARKS

The Office Action dated July 25, 2008 has been received and carefully noted. The following remarks, are submitted as a full and complete response thereto.

Claims 1, 2 and 4-29 are pending in the present application. Claims 1, 2-17 and 24-28 are respectfully submitted for reconsideration.

The Office Action indicated that claims 18-23 have been allowed. Applicants wish to thank the Examiner for the allowance of these claims. Claims 1-2 and 4-17 and 24-29 are respectfully submitted for reconsideration.

In the Office Action, claim 29 was rejected under 35 U.S.C. 112, first paragraph, because the Examiner alleged that there is no support for a computer program claim in the specification as filed. This rejection is respectfully traversed.

Referring to the present application, paragraph [0027] of the detailed description explicitly discloses that the user equipment may be a "computer." Therefore, the location estimation techniques described throughout the claims recitations may certainly be performed on a computer, and hence a computer readable medium. Withdrawal of this rejection is kindly requested.

The Office Action rejected claims 1-2, 4-17 and 24-29 anticipated by 35 U.S.C. 102(e) to Kingdon et al. (Kingdon). The Office Action took the position that Kingdon disclosed all of the features of the claims. This rejection is respectfully traversed for at least the following reasons.

Claim 1, from which claims 2, 4-17, 24 and 25 depend, is directed to a method that includes collecting location information. The method further includes selecting at least one of a plurality of different location methods to provide a location estimate said methods comprising using cell identity information, and determining a first location estimate based on the at least one selected location method. The method also includes determining a virtual base station estimate using at least some of the collected location information, and providing a second location estimate using one of said different location methods based on the first location estimate and the virtual base station estimate, said second location estimate being a location of a mobile device.

Claim 26 is directed to a system that includes collecting means for collecting location information, selecting means for selecting at least one of a plurality of different location methods to provide a location estimate said methods using cell identity information. The system further includes a location determining means for determining a first location estimate based on the at least one selected location method, and an estimate determining means for determining a virtual base station estimate using one of said different location methods. The system further includes a providing means for providing a second location estimate based on at least one of the first location estimate, and the virtual base station estimate. The second location estimate being an estimate of the location of a mobile device.

Claim 27 is directed to a system that includes a collector configured to collect location information. A selector is configured to select at least one of a plurality of

different location methods to provide a location estimate, said methods using cell identity information. A determiner is configured to determine a first location estimate based on the at least one selected location method and to determine a virtual base station estimate. A provider is configured to provide a second location estimate, using one of said different location methods based on the first location estimate and the virtual base station estimate. The second location estimate being an estimate of the location of a mobile device.

Claim 28 recites an apparatus that includes a collector configured to collect location information. The apparatus also includes a selector configured to select at least one of a plurality of different location methods to provide a location estimate. The methods using cell identity information. The apparatus also includes a determiner configured to determine a first location estimate based on the at least one selected location method and further configured to determine a virtual base station estimate. The apparatus also includes a provider configured to provide a second location estimate, using one of the different location methods based on the first estimate and the virtual base station estimate. The second location estimate is an estimate of the location of the apparatus.

Claim 29 recites a computer program embodied on a computer readable medium, the computer program configured to control a processor to perform certain operations. Those operations include collecting location information. Other operations include selecting at least one of a plurality of different location methods to provide a location estimate. The location methods using cell identity information. The operations also

include determining a first location estimate based on the at least one selected location method. Other operations include determining a virtual base station estimate using at least some of the collected location information. Further operations include providing a second location estimate using one of said different location methods based on the first location estimate and the virtual base.

As will be discussed below, the teachings of Kingdon fail to disclose or suggest all of the elements of the claims, and therefore fails to provide the features discussed above. The rejection is respectfully traversed for at least the following reasons.

Kingdon discloses a method for positioning a mobile station 290 using two base stations 320 and 340 (see FIGS. 2 & 3). In operation, when the MS 290/310 is to be positioned, the mobile network 200 will receive a positioning request from some entity operating within the mobile network 200. The request is relayed to the BSC 270 serving the MS 290 or 310. Then, the system attempts to locate the two most suitable BTSs so that a triangulation may be performed. A time advance parameter (TA) is calculated for each BTS and is forwarded to a master positioning center (MPC) 295, which determines the MS 310 distance from each of the BTSs (see column 5, line 50 through column 6 line 13).

However, Kingdon does not teach or suggest, at least, "determining a virtual base station estimate...and...providing a second location estimate using one of said different location methods based on the first location estimate and the virtual base station estimate, said second location estimate being a location of a mobile device", as recited, in part, in

independent claim 1 and similarly in independent claims 26-29. The Office Action alleged that column 6, lines 1-62 and column 7, lines 40-50 of Kingdon discloses the above-noted features of the claims (see page 4, line 8 of the Office Action). Applicants disagree and submit that the base stations disclosed in Kingdon (e.g., BTSs, BSCs, etc.) all must be real base stations and cannot be interpreted as being virtual base stations. For instance, the serving base station is by its very nature and definition a real (non-virtual) base station because it provides actual communication services to the mobile station in a known and open-ended manner.

Referring to column 6, lines 30-32 of Kingdon, the timing advance (TA) measurements for the mobile station are measured at two known and real base stations (BTS 120 and serving BTS 110) actively participating in the communications of the mobile network 200. The timing advance parameters and the cell identifiers of the base stations are used to position the mobile station based on one of two areas that correspond to a distance equivalent to the TA measurement from each base station. In order to determine which of the two base stations provides the correct location of the mobile station, the serving base station sector is determined. The serving base station BTS 110 is the real and actual serving base station that is used in the initial position determination.

Contrary to the disclosure of Kingdon, independent claim 1 recites, in part, "providing a second location estimate using one of said different location methods based on the first location estimate and the virtual base station estimate" to determine the location of the mobile device (emphasis added). The first and second location estimates

of the BTSs disclosed in Kingdon are not based on each other such that one can be considered a first estimate that is actually used to determine a second estimate. Because Kingdon does not base a first estimate on a second estimate, Kingdon cannot possibly determine a second estimate based on a first estimate and a virtual base station estimate, as recited in the pending claims. Kingdon simply fails to disclose performing a location estimate comparable to the claim recitations of the present application.

Therefore, for at least the reasons stated above, Kingdon fails to teach all of the subject matter recited in independent claims 1 and 26-29. By virtue of dependency, claims 2, 4-17 and 24-25 are also allowable over Kingdon. Withdrawal of the rejection of claims 1, 2 and 4-17 and 24-29 is kindly requested.

Applicants respectfully submit that each of claims 1, 2, 4-29 are in condition for allowance. Accordingly, it is respectfully requested that each of claims 1, 2, and 4-29 be allowed, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicants' undersigned representative at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

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